STOCKHOLM SCHOOL OF ECONOMICS
Department of Economics
5350 Master's thesis in economics
Academic year 2015 - 2016

Fending off Waste from the West

Effects of the Operation Green Fence on the International Waste Trade

Adomas Balkevicius (40801) and Sigita Zvirblyte (40800)

Abstract

Existing international legislation has been shown to have little impact on the waste trade flows from developed to developing countries. Our paper is the first to explore the effect of unilateral action of enforcing more stringent domestic regulation on the international waste trade. We study the Operation Green Fence (OGF), a 10 month long intervention in China that strictly enforced existing waste import standards. We assess the short-term effects of the OGF on the non-hazardous waste exports from developed countries to China and to other developing countries. Taking advantage of the natural experiment setting and high quality international trade panel data, we run a fixed effects gravity model and claim causal effect of the OGF. During the OGF we find a 24% average drop in low quality waste exports to China from developed countries and a 16% increase in exports to other developing countries. We find no empirical evidence that the low quality exports were disproportionally absorbed by countries with lax environmental legislation. We conclude that strictly enforcing rigid domestic waste import environmental regulation within large developing waste importers is an effective tool to reduce low quality waste flows into the country and to possibly reduce the overall waste flows from developed to developing countries.

Keywords: Operation Green Fence, Waste, International trade, Environmental regulation, Gravity model, Recycling
JEL: F18, F64, Q53, Q56

Supervisor: Mark Sanctuary
Date submitted: May 23, 2016
Date examined: May 31, 2016
Examiner: Kerem Cosar
Discussants: Mattias Almqvist, Srinidhi Srinivasan

Contents

List of Figures

List of Tables

Acknowledgements

We would like to thank our supervisor Mark Sanctuary for invaluable help and guidance. We are indebted to him for his support and patience throughout the process. In addition we would like to thank Rickard Sandberg for the support with econometrics.

We are grateful to Tomás Vasconcelos, David Rydén and José Araújo for their useful insights and valuable feedback, as well as for keeping us clear-headed throughout the research.

1 Introduction

International waste trade is a quickly growing 250 million tonnes industry,[1] increasingly characterized by waste flowing from developed to developing countries. Waste trade benefits importers with cheap recyclable materials, but also brings non-recyclable waste, harmful to environment and population's health. Given the limited resources developing nations have to deal with the detrimental outcomes, the international community attempted to control waste flows via international regulation, albeit with a limited success. Supporting stronger domestic regulation may be a more effective alternative. However, there is little research addressing the topic. To aid the understanding of domestic regulation effect on the international waste trade, we undertake the first academic study of the Operation Green Fence (OGF), a 10 month long intervention by the government of China that strictly enforced existing domestic waste import standards. China alone accounts for 22% of the global waste imports (UN Comtrade 2016), and by enforcing national quality standards during the intervention, the country disrupted the international waste market.

The goal of the paper is to study the effect of the OGF on non-hazardous waste exports from developed countries to China and to other developing countries. First, we hypothesise that low quality waste exports from developed countries to China decreased during the intervention.[2,3] Waste haven theory suggests that the waste would have been diverted to destinations with the least stringent environmental regulation. Hence, our second hypothesis is that during the OGF waste exports from developed countries to developing countries[4] with lax environmental regulation increased.

Taking advantage of the natural experiment setting of the OGF and high quality international trade panel data available from UN Comtrade and US Census Bureau, we run fixed effects gravity model to test our hypotheses. We argue that the OGF took exporters by surprise, which allows us to measure the causal effect of the OGF. We find that during the OGF lower quality waste exports from developed countries to China decreased while the waste exports to other developing countries grew during the same period. However, we find no evidence that the waste flows were disproportionally diverted to the developing countries with the most lax environmental regulation.

In the next section (section 2) we provide some background on the international waste trade and the OGF, followed by the review of academic literature on the subject (section 3). We then discuss the methodology and chosen methods (section 4), followed by the data overview (section 5). We then present the empirical results, split into two parts: first, we assess the OGF effect on low quality exports from developed countries to China in section 6.1 and then the OGF effect on exports to other developing countries in section 6.2. After the results section, we shortly discuss the robustness checks we ran for our model (section 7). Then we proceed with the discussion of the results in a broader context of international waste trade (section 8) and finally conclude with the closing remarks in section 9.

[1] According to UN Comtrade (2016) the total waste exports in 2014 amounted to 250 million tonnes.
[2] Developed countries are identified as countries that are part of EU and/or OECD.
[3] China includes mainland China and Hong Kong, but not Macao.
[4] Developing countries are identified as countries that are not part of EU nor OECD.

2 International waste trade and the Operation Green Fence

2.1 International waste trade

International waste trade is a quickly growing industry. In 2014, international waste flows increased by another 2 million tonnes (UN Comtrade 2016). This growth in scrap waste trade has been driven by economic incentives - recycling materials are cheaper than primary mining (Chaturvedi and McMurray 2015). The biggest share of waste imports is accounted for by developed countries, but developing countries are importing a disproportionally large share compared to their waste production (Kellenberg 2015). In 2014, developing countries accounted for 20% of the waste exports, but imported more than 44% of global waste exports (UN Comtrade 2016).

With the continuing growth of the waste trade, the debate over its environmental consequences continues. Some economists are arguing the benefits of the trade to the developing nations (Johnson, Pecquet, and Taylor 2007) and many are examining the costs (Ray 2008; Chintrakarn and Millimet 2006; Kellenberg 2008). Prevailing attitude in the international community is that some trade, such as hazardous waste trade, should be heavily regulated, because the developing nations have lower resources to handle such types of wastes, exposing the populations to substantial health risks. In response, the international collaboration has been trying to control hazardous waste flows through international agreements, leaving other types of waste regulation largely up to individual governments.

The key international treaty drawn to regulate the transnational movements of hazardous waste is Basel Convention. It came into force in 1992, as a binding legislation that requires hazardous waste exporters to have a prior written notification from the competent authorities in the country of import and in any transit states (Secretariat of the Basel Convention 2005). In 1994, the framework was supplemented by Basel Ban, forbidding OECD and EU countries to export hazardous wastes to non-OECD and non-EU countries, stating that "transboundary movement of hazardous wastes from OECD to non-OECD countries have a high risk of not constituting an environmentally sound management of hazardous wastes as required by the Basel Convention" (Secretariat of the Basel Convention 1999). However the ban has not been ratified by all of the countries involved.

On the other hand, global trade of non-hazardous waste have largely escaped the legislators' focus. One reason for it is that scrap trade is often viewed in a positive light, because it brings valuable materials to the importers. However, there are reported cases where the contaminants that come with scrap waste are found to be hazardous, or the hazardous waste is falsely labelled as non-hazardous (Asia Times 1999). In addition, waste trade brings secondary pollution in a form of other non-recyclable contaminants, which end up in the developing countries. While the effects are not immediate, there is a significant amount of secondary pollution accumulating in the developing countries. This pollution harms environment and population's health in a longer term (Alam and Ahmade 2013).

China currently accounts for the largest share of global waste imports, receiving 22% of scrap shipped globally, which amounted to approximately 55 million tonnes in 2014 (UN Comtrade 2016). The rapid expansion of manufacturing sector in China required cheap materials and led to the growth of scrap imports. Also, due to the labor-intensive nature of non-hazardous waste recycling, China, being labor abundant, was an attractive destination. Furthermore, as developed countries became net importers of finished goods from China, ships left China fully loaded, but came relatively empty. As a result, the shipping costs to China were lower than shipping costs from China, which made recycling business even more profitable (Velis 2014). Some sources argue, that this reverse haulage is the main advantage of China over other developing countries competing for recyclable materials, such as India, and one of the main reasons why China has become the dominant importer of scrap waste (Chaturvedi and McMurray 2015).

In February 2013, China launched the Operation Green Fence (OGF) in an attempt to enforce existing waste import quality regulations. Given China's importance as a global importer of waste, the OGF has significantly disrupted the waste trade market (Chaturvedi and McMurray 2015). In this paper, we study the effects of the OGF intervention on the waste exports to China and other developing countries.

2.2 The Operation Green Fence

The Operation Green Fence (OGF)[5] was launched by the General Secretary Xi Jinping of the Communist Party of China (CPC) in an attempt to fight waste smuggling into China. The operation started on the 1st of February 2013 (General Administration of Customs 2013), taking the waste exporters by surprise (Recycling Today 2014; Jansen 2013). The OGF lasted 10 months until the 31st of November 2013, disrupting the recycling industry (Chaturvedi and McMurray 2015). While the OGF started unexpectedly, the market knew in advance that the intervention was meant to last for 9 to 10 months (Recycling International 2013b).

The OGF set out to strengthen management of imported foreign waste and punish the parties that break the laws of import of solid waste management practices in China (General Administration of Customs 2013). The key objectives were to strengthen the interception of illegal waste shipments and to crack down on existing routes of illegal waste smuggling. The OGF did not introduce new national standards or regulations, but enforced the existing laws much more effectively (Hong Kong Information Services Department 2013). It required inspection of imported wastes destined for recycling at all ports in China (HKPC 2014). Market sources estimate that around 70% to 90% of containers were subject to random inspection during the OGF (Recycling International 2013a). The inspection covered all forms of imported waste destined for recycling (such as metal, plastic, recovered paper materials, rubber and textiles) and rejected all shipments that had a higher contamination rate than the allowed 1.5% (Vangel Inc. 2013).

The purpose of the OGF was to limit the costs for domestic manufacturers associated with sorting out the waste contaminants and to limit environmental pollution (Flower 2016). The intervention lasted only 10 months, but it was a strong signal for the international waste exporters that China is no longer importing low quality scrap. Also, the OGF meant that exporters have to consider the risk of China taking a similar action in the future.

The OGF enforced existing waste import standards, with the most recent legislation change passed in April 2011. The laws required an importer to obtain a non-transferable license from General

[5]In Simplified Chinese 绿篱 .

Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and set the level of allowed contamination in scrap waste shipments. In addition, the legislation banned all hazardous waste imports, even for purposes of re-export (Ministry of Environmental Protection of the People's Republic of China et al. 2011).

By definition, any waste affected by the OGF was illegal, as the OGF only enforced existing laws. Nevertheless, it is beyond the scope of our research to assess the motivation of potentially affected waste shipments (whether it was intentionally mislabeled waste or unintentionally lower-than-required quality waste; most likely it was a mixture of the two).

Due to a lack of academic research, the discussion of the effects of the OGF is currently limited to industry and news sources. Despite their anecdotal nature, there is a general market agreement that the OGF resulted in a decrease in imports of recyclable wastes in China (Powell 2013). According to the General Administration of Customs, around 976,500 metric tons of illegal waste material were intercepted during the intervention (China.org.cn 2014). National sources state that imported waste that meets existing national standards was not affected (HKPC 2014), which suggests that the decline in imports to China is a direct result of illegal waste shipments. Nevertheless, not all market players agree. Some exporters argue that the inspection of this scale caused customs delays, which in turn caused the slowdown of imports and increased costs (Recycling International 2013b).

In addition, it was argued that during the OGF the waste was diverted to other developing countries, such as Vietnam, Indonesia and Malaysia, either for cleaning and resubmission to China or as the final destination of waste (Recycling International 2013c). Also, some large market players argued that the OGF spurred domestic innovation that enabled exporting countries to recycle more waste themselves (MBA Polymers 2013), or to send it to domestic landfills (Earley 2013), which would have decreased overall export volumes. This paper examines the significance of the OGF to determine whether the intervention resulted in statistically significant changes to exports from developed countries to China and other developing countries during the intervention.

3 Literature review

The increasing proportions of the waste trade flowing into developing nations have not escaped environmental economists (Kellenberg 2015). Nevertheless, our paper stands out amongst the first to explore the effectiveness of domestic legislation as a tool to control international waste trade flows. In this section, we will describe the current debate on the impact of international waste trade on developing countries, and the limits of international legislation. We will briefly discuss a relatively new theory of waste havens and the pollution haven theory, which has been central to waste trade research. Due to limited academic research on the OGF so far, we shortly discuss an industry paper that attempted to look into the waste trade dynamics and the OGF effects. Finally, we briefly describe the gravity model, which underpins our econometric model.

The findings on the effects of international waste trade, especially impact on importing developing countries, have been mixed. Kellenberg (2015) points out that while social impact of the waste trade is unknown, it might bring benefits in terms of job creation and industry growth. Nevertheless, it is unclear if these benefits can outweigh the costs of environmental pollution and increasing health risks. Chintrakarn and Millimet (2006) found significant negative trade effects on the environment on the majority of selected measures, while Ray (2008) argued that scrap trade with Asian nations have adverse environmental and economic impact outweighing any benefits. On the other hand, Johnson, Pecquet, and Taylor (2007) argued, that when differences in health and life expectancies are accounted for between developed and developing countries, the gains from migration of dirty industries will result in economic growth in developing nations.

In an attempt to limit the negative aspects of the international waste trade, international community attempted to control hazardous flows through international environmental regulations. Nevertheless, the impact of the legislation is vague, even of Basel Convention, the most successful global waste regulation with legally binding framework and with a relatively high number of ratifications (183) (Secretariat of the Basel Convention 1999). Krueger (2001) identified the international consensus as the key achievement of the Convention, unable to measure the true impact on the waste flows. Pratt (2011) made a similar argument that Basel Convention provides a foundation in this area, but suffers from many implementation loopholes. Kellenberg and Levinson (2014) employed a detailed United Nation's international trade data set to examine the Basel Convention effects on the total waste trade, finding no evidence that the Convention restricted the overall waste trade in any way.

Given the lack of effectiveness of international legislation, supporting domestic regulation offers an alternative tool for the international community. However, there is a lack of research on the effects of domestic environmental laws on international waste trade. Kellenberg (2012) was the first to test the waste haven theory, which states that the differences in domestic environmental laws might result in the exports of waste streaming to less regulated countries. The author found the effects to be statistically significant and substantial, concluding that more stringent domestic environmental policies will result in lower waste imports amongst some pairs of trading countries.

While there is limited academic research exploring waste haven theory, there are numerous academic studies focusing on exploring pollution haven theory. The theory states that due to relatively lax environmental regulations in less developed countries to attract businesses, the costs for polluting industries are lower, and these countries will likely become hubs for such industries (Levinson and Taylor 2008; Xu and Song 2000). Pollution haven theory differs to the waste haven theory as the latter concerns the movement of waste by-products rather than the movement of whole dirty industries (Levinson and Taylor 2008). In turn, pollution haven theory seems to address longer term effects. Given the importance of the pollution haven theory in the legislative (the theory underpins Basel Convention) and environmental context, it has been widely studied by environmental economists (Levinson and Taylor (2008), Baggs (2009), and Jaffe et al. (1995), to name a few).

The pollution haven studies have been largely focusing on hazardous waste trade, with little research into global non-hazardous waste trade flows. Nevertheless, Kellenberg (2012) argues that studying non-hazardous waste might be more important in understanding environmental effects of the global free trade. Given the significant scale and growth of the waste trade, focus limited on hazardous waste does not capture the full picture of the externalities. In addition, some of the hazardous waste may be labelled as non-hazardous waste to circumvent the regulations (Japan Ministry of the Environment 2011), so studying the international waste trade encompasses elements of criminal activities.

Given the limited effectiveness of international legislation, our paper concentrates on examining domestic legislation effects, which could be translated into action by local governments or international organisations. Specifically, we propose to look at the effects of the OGF enforcement of more stringent regulation on the largest importer of scrap waste - China. The setting of the intervention allows us to focus only on non-hazardous waste, as any hazardous waste imports are prohibited in China during our period of focus (Ministry of Environmental Protection of the People's Republic of China et al. 2011).

The most detailed review of the OGF effects to date is provided by Chaturvedi and McMurray (2015) in a report for the Institute of Development Studies (IDS). The authors discussed the rise of China as a global recycling hub and its effects on other countries moving towards circular economy, dedicating a large part of analysis to the OGF effects. The paper investigates trends in waste trade data and provides a snapshot of waste trade flows for India, UK and Germany during the OGF. The authors find that there has been a substantial increase in paper waste imports in India during the OGF period, with UK reporting 40% higher levels of waste paper exports to India than usual. Nevertheless, the analysis that the authors provide is mostly based on visual inspection of the data and an econometric analysis is needed to evaluate the OGF. Our paper sets out to fill in this gap.

4 Methodology

To assess the impact of the OGF on the waste exports to developing countries we divide our paper into two parts. First, we test our first hypothesis whether there was a decrease in waste exports to China during the OGF. Second, we examine whether there was an increase in the waste exports to other developing countries and test our second hypothesis if developing countries with lax environmental regulation absorbed the potentially re-directed waste flows. To test the hypotheses we use a fixed effects gravity model, popular in the international trade literature. In the following section we will introduce gravity model in the context of international waste trade, followed by the econometric models used in the paper.

4.1 Gravity model in international waste trade

As previously mentioned, to investigate the effects of the OGF we use a fixed effects gravity model. Gravity model allows us to control for relative differences between exporting and importing countries by including controls for relative economy sizes and relative capital endowments. As Kellenberg (2008) argued, relative differences between the trading country pairs may result in increased waste flows.

The gravity model has become the workhorse model in research attempting to predict bilateral trade flows based on the sizes and similarities between trading partners. The success of the model is due to its high explanatory power and consistency with imperfect competition and trade, and Heckscher-Ohlin models. Scrap waste has economic value as it can be recycled to materials used in production processes, and can be interpreted as an intermediate good in gravity model context (Kellenberg and Levinson 2014). In result, the gravity model is widely applied in international trade as well as international waste trade: Baggs (2009) and Kellenberg (2012) applied gravity models to explore the variation in the waste trade. Kellenberg and Levinson (2014) have combined a gravity model with Harmonized System (HS) tariff codes to analyze the effects of Basel Convention. [6]

The key controls of a gravity model include capital endowment differences, costs of engaging in the trade (distance, transportation costs), the similarities of trading countries (sizes of economies, as well as common language, common border and colonial ties) and overall sizes of bilateral countries (Ghosh 2011). In addition, Kellenberg (2015) identifies domestic environmental regulations as one of the key determinants of the international waste trade flows, amongst disposal costs, taxes, transport costs and presence of criminal organisations. Grossman and Helpman (1994) also make an argument for political environments having a significant impact on the trade policies and trade volumes.

We build our fixed effects gravity motivated by the influential paper by Baltagi, Egger, and Pfaffermayr (2003). In addition to controlling for overall country's economy size, similarity between economy sizes of country pairs, and differences in factor endowments between the country pairs as the authors recommend, we add transport costs and reverse haulage explanatory variables, that are specific to the international waste trade. We choose a fixed effects model to take the full advantage of our panel data and control for observed and unobserved time-invariant exporter-importer-waste type heterogeneity in order to estimate the causal effects of the OGF. Please see section 4.3 for detailed discussion of fixed effects.

4.2 Econometric model

We use variations of the same model with fixed exporter, importer and waste effects to test our first and second hypotheses, so we present them one by one.

First, we evaluate the immediate effect of the OGF on the waste exports to China from developed countries. Since the sample is limited to exports to China, we use a triple indexed equation:

$$y_{ewt} = \mathbf{x'}_{et}\beta + \alpha_{ew} + t_{wt} + \delta_0 \times OGF_t + \delta_1 \times OGF_t \times lowQexp_{ew} + \epsilon_{ewt} \tag{1}$$

where the dependent variable y is the natural logarithm of the weight of waste type w (6-digit HS code), exported by a country e to China at time t. $\mathbf{x'}_{et}$ is a row vector of explanatory variables, controlling for shipment costs ($lnBDI_t$), reverse haulage ($lnIMP_{eit}$), overall country pairs size ($LGDT_{eit}$), relative bilateral country sizes ($LSIM_{eit}$), and relative factor endowments between trading country pairs ($LRFAC_{eit}$) (please see section 5.2 for detailed description of these variables). α_{ew} captures the exporter-waste fixed effects and t_{wt} is the waste type specific time trend. We are interested in the OGF time dummy variable (OGF_t) and the interaction term $OGF_t \times lowQexp_{ew}$ that captures the additional OGF effect for the exporters that export the lowest quality waste for each type of waste.[7] The full conditional effect of the OGF for the lowest quality exporters would

[6] HS tariff system is an internationally standardized system to classify traded goods by assigning them with standardized codes and names.

[7] $lowQexp_{ew}$ dummy takes a value of 1 for the bottom quartile of exporters that have exported the cheapest waste

be captured by $\delta_0 + \delta_1$.

Then, we test our second hypothesis and explore the trade effect of the OGF on waste exports coming from developed to developing countries other than China. We further divide our analysis into two phases: we first examine if the OGF affected the waste exports to these developing countries and, if we find a positive effect of the OGF, we study whether the additional waste was sent to the lax environmental regulation destinations.

To examine whether the OGF affected exports to other developing countries, we run the regression below. The regression is very similar to equation (1); however, our panel member now is exporter-importer-HS rather than exporter-HS as before, resulting in the addition of index i that indicates an importer. Also, the vector of explanatory variables is different.

$$y_{eiwt} = \beta \mathbf{x'}_{eit} + \alpha_{eiw} + t_{iwt} + \delta_0 \times OGF_t + \delta_1 \times OGF_t \times lowQexp_{ew} + \epsilon_{eiwt} \tag{2}$$

where y is the logarithm of the weight of waste exports,
$\mathbf{x'}_{eit}$ is a vector of explanatory variables: transport costs ($lnBDI_t$), reverse haulage ($lnIMP_{eit}$), and economy size of exporter ($lnGDP_{et}$)[8]
α_{eiw} is the exporter-importer-waste fixed effect
t_{iwt} is the importer and waste type specific time trend
OGF_t is the OGF dummy
$lowQexp_{ew}$ is a dummy variable for low quality waste exporters

After running this regression, we can conclude if the OGF resulted in the exports increase to other developing countries and move on to our second phase of testing the second hypothesis: whether countries with lax environmental regulation absorbed the increase in waste exports to other developing countries. We test it using two different identification strategies for the stringency of the environmental regulation: by using the environmental regulation index we create a dummy for the least stringent countries (lax_i) and identify the lowest quality waste importers ($lowQimp_{iw}$).

$$\begin{aligned} y_{eiwt} = \beta \mathbf{x'}_{eit} + \alpha_{eiw} + t_{iwt} + \delta_0 \times OGF_t + \delta_1 \times OGF_t \times lowQexp_{ew} + \delta_2 \times OGF_t \times ENV_{iw} \\ + \delta_3 \times OGF_t \times lowQexp_{ew} \times ENV_i + \epsilon_{eiwt} \end{aligned} \tag{3}$$

where y is the logarithm of the weight of waste exports
$\mathbf{x'}_{eit}$ is a vector of explanatory variables: transport costs ($lnBDI_t$), reverse haulage ($lnIMP_{eit}$), and economy size of exporter ($lnGDP_{et}$)
α_{eiw} is the exporter-importer-waste fixed effect
t_{iwt} is the importer and waste type specific time trend
OGF_t is the OGF dummy

to China during 2012 for each type of waste (and 0 otherwise). These exporters were identified by calculating the average price of waste exports per kg for each waste type.

[8] We exclude variables $LGDT_{eit}$, $LSIM_{eit}$,$LRFAC_{eit}$, and add $lnGDP_{et}$ variable to account for exporter's size of GDP to limit any bias from excluding these variables. Please see subsection 5.2 for more information

$lowQexp_{ew}$ is a dummy variable for low quality waste exporters
ENV_{iw} is a dummy for environmentally lax regulation in importing country, lax_i and $lowQimp_{iw}$

In further sections, we provide detailed descriptions of the structure of our model. For detailed description of dependent and explanatory variables please see sections 5.1, 5.2 and 5.3. For summary statistics for our explanatory variables, please refer to Appendix 10.1 Tables 5 and 6.

4.3 Fixed effects

One of the key strengths of our model is the use of fixed effects. We use the fixed effects in order to capture all time invariant effects, typically included in a traditional gravity model, such as distance, common language, common border and colonial ties. Furthermore, fixed effects capture unobservable time invariant variables. In addition, slowly changing characteristics, such as a relative size of economy, dominant industries, labor abundance, population size, political structure and regulation, organized crime level and corruption level are also accounted for by the fixed effects during our relatively short focus period. Inability to measure the effect of these theoretically important variables is often considered as a cost of fixed effects (Kareem and Kareem 2014). However, our focus is on assessing the impact of a policy at a known time, so we are primarily interested in the variation *within* the panel members and the risk of omitted variables outweighs potentially interesting findings about the effects of time invariant variables.

The choice of fixed effects instead of random effects is based on theoretical and empirical grounds. Fixed effects allow arbitrary correlation between exporter-waste specific effect α_{ew} (please see equations above) and the independent variables, which makes it more appropriate for estimating ceteris paribus effect (Wooldridge 2013). In addition, the Hausman test indicates that the fixed effects specification is more appropriate than the random effects.[9] We cluster the errors over the waste type to allow for within-cluster correlation and implement a cluster-robust version of the Hausman test by Schaffer and Stillman (2006) as recommended by Cameron and Miller (2015).

We refrain from including main time fixed effects and interaction time fixed effects as suggested by Baltagi, Egger, and Pfaffermayr (2003) for multiple reasons. First, the OGF is a time effect that has affected all exporters and potentially all importers at the same time. Including time fixed effects would absorb the effect of the OGF, which is of primary interest here. Second, waste trade remains volatile even when aggregated to quarters. Including quarterly main and interaction time effects could mistake the natural volatility of the waste trade for explanatory time effects. Third, we limit the sample to a relatively short span of 10 quarters, during which the OGF was the key time-shock to the waste trade. There may have been other, smaller time shocks, but we mitigate the risks of potential bias by including the importer-waste-specific time trends and other time variant controls. As a result, any remaining bias due to omitted time effects would be small.

[9] We tested the fully specified regression (1) and with a p-value of 0.0000 we convincingly reject the Hausman null hypothesis and conclude that the fixed effects model is preferred to random effects.

4.4 Potential concerns

There are two potential concerns we should address in this section - exclusion of the price term and managing zero trade flows. We exclude the waste price from the model, because price is endogenous to the OGF. Since China is a major importer of wastes, the OGF may have created a price shock in the market. Due to the rejection of low quality waste within China, the market for this waste disappeared, and might have caused the prices to collapse for low quality waste. On the other hand, with local manufacturers demanding for recyclable waste, the prices for some wastes might have jumped (MBA Polymers 2013). In addition, if recycling became more cumbersome due to longer custom clearing times, then slower delivery times could potentially push manufacturers to switch to virgin alternatives, thus decreasing the waste prices. Overall, while the effect of the OGF on weight of waste exports to China can be interpreted as an effect of stronger enforcement of environmental regulations, the interpretation of the effect on prices is not as straightforward.

Second concern we have to address is the treatment of zero trade flows in our data. Zero trade flows appear in the data when there was no waste trade between the two parties. The two usual methods to deal with zero trade flows are to truncate - constrict sample to non zero trade flows, or to censor - substitute zeros with very small constant (Kareem and Kareem 2014). We follow Kellenberg (2012) and choose to truncate our sample, because supplementing even small numbers instead of zeros might cause bias, given the data source we use (UN Comtrade data accounts for weight down to a single gram). We use the logarithmic transformation that automatically emits zero trade flows.

Linders (2006) argued that if the zero trade flows do not occur randomly, disregarding them can bias the empirical results as zeros carry information about the probability to engage in a bilateral trade (Linders and De Groot 2006). In theory, the zero trade flow is non-random if a country makes a decision not to trade with another country due to some specific variables at hand. If the zeros are non random, disregarding them may cause downward bias underestimating the coefficients of the model (Kareem and Kareem 2014). In addition, Xiong and Beghin (2001) pointed out that without accounting the zero trade flows, one cannot explore the trade on the extensive margin (trade creation) (Xiong and Beghin 2011).

Nevertheless, we argue that this bias will be limited in our case, due to our restricted sample and characteristics of the waste as a commodity. First, because we focus only on the exports by developed countries, much of bilateral zero trade flows are excluded from our sample already. Second, when we investigate the potential drop in the waste exports due to the OGF, it is unlikely that exporters immediately find new trading partners or that the exports to China are abruptly suspended, since China is a major importer and our sample is relatively short. Third, waste is a by-product of consumption and production, and is not produced on demand. Hence, the zero waste flows in our sample will most likely be due to domestic factors in exporting country and not due to conscious decision of not to trade. Finally, to further mitigate the risk of missing information of zero trade flows we collapse our monthly data into quarterly data.

Considering the possibility that there remain zeros in our quarterly data due to an exporter's decision not to engage in a trade with China during the OGF, it would introduce a downward bias in our estimates. Exclusion of zeros might lead to underestimating the true underlying coefficients, bringing them closer to zero. However, if we find that the OGF did reduce the waste exports to China, it would be despite the bias, not because of it. In result, we argue that any bias due to zero trade flows will be small, and if our results are affected, the effect would be small and negative.

5 Data

In this section, we go into detail describing the dependent and independent variables in our model. First, we discuss our waste exports panel data set, introducing the data sources, definitions of developed and developing countries at hand, the process of data cleaning, and reasoning behind choosing the specific sample length. In addition, we describe time-variant controls and conditional controls thoroughly in further subsections.

5.1 Panel data set

The main data source for our panel data is the United Nations Comtrade database (UN Comtrade 2016), supplemented by the official US trade statistics (US Census Bureau 2016). UN Comtrade contains international merchandise trade statistics reported up to 6-digit level of the Harmonized System (HS) classification. HS classification assigns a code for each product category. The database is compiled mostly from national statistics offices and contains weight and value of international trade flows.[10] We supplement the data set with US Census Bureau statistics for USA, because UN Comtrade database has only USA export value (but not weight) data on a quarterly basis. We expect no bias from merging the data sets, since UN Comtrade reports US Census Bureau as the main source for the USA data.

To identify waste among all other international trade flows in our data set, we included 6-digit HS codes that contain words 'waste' or 'scrap' in the description of a code. A similar way of identifying waste has been used before by Kellenberg and Levinson (2014). To make sure that we did not miss any important wastes, we cross-checked the identified HS codes against the HS codes covered by environmental protection control standards of the People's Republic of China for imported solid wastes (SEPA and AQSIQ 2005) and HS codes that require an overseas supplier to hold a recycling certification (AQSIQ 2016). According to memos released by China's government institutions, all categories of waste were inspected during the OGF and the government has not specified a concrete list of affected HS codes (General Administration of Customs 2013). Thus, it is unlikely that waste exporters were able to avoid customs checks by re-classifying the exports from one waste HS code to another waste HS code, but we investigate this possibility in more detail in section 7.[11] Please refer to the Table 8 in the Appendix 10.2 for the list of HS codes that have been included in the final data sample.

[10] Value of exports excludes shipping costs. Please refer to the UN Comtrade glossary for full definitions (UN Comtrade 2016).

[11] We run a robustness check by limiting the sample only to the waste codes that are mentioned in the environmental protection control standards (although there is a large overlap of HS codes identified by using keywords and HS codes mentioned in China's regulations).

Though our focus is on non-hazardous waste, five of these waste codes are identified as hazardous or partially hazardous by Basel Convention.[12] Nevertheless, non-hazardous materials will fall under these codes as well. For example, 780200 lead waste or scrap is categorized as hazardous waste under Basel Convention, but according to Jacobs (1995) the code encompasses four categories of lead, one of them identified as typically hazardous, and one as typically non-hazardous.[13] Given that China had a ban on all hazardous waste imports during our period of focus (please see section 2.2), we assume that all materials shipped to China under these codes were non-hazardous, and any other instances will fall under illegal activity. In turn, all waste exported to China can be treated as a 'good' rather than a 'bad', meaning that it has economic value as a production material.

5.1.1 Defining waste flows from developed to developing countries

For the purposes of this paper we define developed countries as countries that are part of European Union and/or OECD. All other countries are defined as developing countries, despite their wealth. We use this definition in accordance to the one used in Basel Convention[14] and Kellenberg (2015) paper. In addition, some waste export destinations have not been reported and fall under 'other' category (e.g. Other Asia). Please refer to the Table 7 in the Appendix 10.2 for the list of countries that have been included in the final data sample.

We focus on exports to China and other developing countries, because we want to understand the exporters' behaviour during the OGF. A closer look into import flows into China could provide further insights, but the access to China import data is limited[15] and it is beyond the scope of our research. Nevertheless, it would be an interesting area for further research to compare the export data reported by developed countries with the import data reported by China.

When assessing waste trade flows to China, we have to keep in mind that Hong Kong acts as an intermediary port for waste entering China. Kojima and Yoshida (2005) found that 99% of re-exports of recyclables from Hong Kong went to China. Thus, we follow the common practice of adding up exports to Hong Kong with exports to China and look at the total volumes as a single import destination 'China' (Chaturvedi and McMurray 2015).

5.1.2 Data cleaning

We clean the data set by removing a few outliers. First, we remove very rarely traded HS codes that were not exported to China during the OGF. By visually inspecting the data we confirm that the removed codes have no observations during the OGF because of infrequent shipments (and not because of a sudden stop during the OGF). In the end, we have 54 waste 6-digit HS codes that are

[12] Namely, 262019 Ash or residues containing mainly zinc (not spelter); 411520 Parings & other waste of leather/composition leather, not suitable for the manufacturing; 470790 Waste, scrap of paper, board, other (including unsorted); 700100 Glass cullet, waste of scrap, glass in the mass; 780200 Lead waste or scrap.

[13] We do not include any of hazardous codes that do not encompass a proportion of non-hazardous materials, or codes that are non-recyclable.

[14] Developed countries are those listed in Annex VII of the Basel Convention.

[15] During the time of writing, the trade data of waste imports (as opposed to exports) to China from developed countries during 2013 was not available from UN Comtrade database.

included in the data set. Then we remove Iceland from our data set to avoid any bias, due to a new Free Trade Agreement (FTA) with China signed during the OGF on April 15, 2013 (Ministry for Foreign Affairs of Iceland 2016). We do not expect that excluding Iceland would have a significant effect on results, since it exports very little waste to China. Then we remove the Republic of Korea from the developed exporters list, because UN Comtrade data contains only waste exports for 2014. This is most likely due to a data collection problem (and not because there was actually no trade between the two countries).

Finally, we remove Estonia, Greece and Slovakia, because in the data set these exporters have an unprecedented spike in the waste exports during 2013 right after the OGF.[16] We offer three possible explanations. First, the spike may be a result of these countries holding back low quality waste exports during the OGF and once the OGF has finished, exporting all waste that was held up in one go. Second, the OGF may have created a bottleneck that resulted in a shortage of materials for recycling in China and these countries met the demand right after the bottleneck was removed, shipping all waste at their disposal. The third possible explanation is a data collection error.

The first and second explanations have multiple shortcomings. The spike is present only for the three waste exporters and it is abnormally large - reported quarterly waste exports at the end of 2013 just for Estonia, Greece and Slovakia exceed the quarterly waste exports by all other developed exporters combined. The delayed shipment theory seems unlikely as relatively small populations of these countries would not be capable of naturally producing such a disproportionally large amount of waste in a short time. There is a possibility that the shipments were preplanned or diverted from other countries, but even then it makes little economic sense to divert waste shipments to China via landlocked Slovakia. Regarding the domestic shortage argument, the potential decrease in waste exports during the OGF is nowhere as sizable.

It would be an interesting topic for further research to investigate whether the spike in waste exports was legitimate and what were the reasons for it. However, it is beyond the scope of our research and we remove the identified exporters from the data set to avoid potential bias to the results. We argue that the spike is likely to be exogenous to the OGF, it happened mostly after the OGF and removing the three exporters from the sample should not have a large effect on the estimates of the immediate OGF effect.

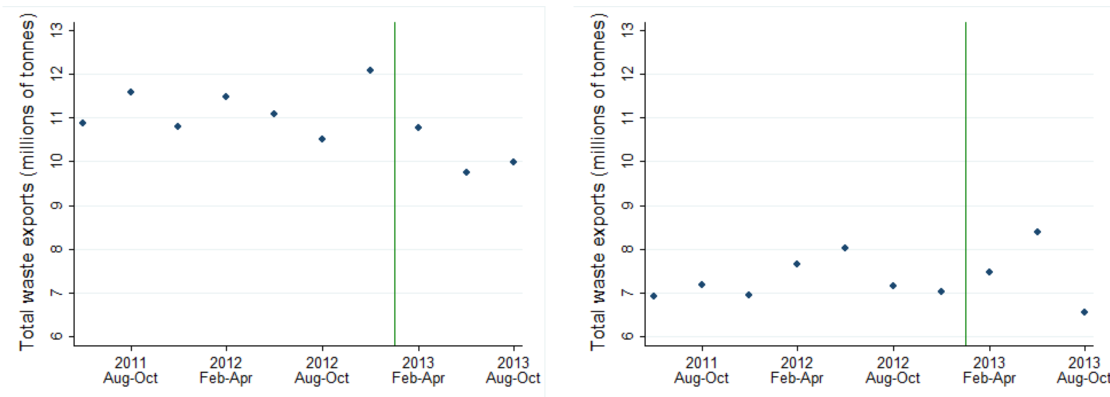
5.1.3 Visual inspection

We can observe general waste export patterns during the time of interest in the Figure 1. From the visual inspection it seems that the overall waste exports to China from developed countries in Figure 1a were relatively stable before the OGF and there was somewhat of a decrease in the waste flows during the OGF, more prominent during the later phase from May to October. The waste exports to other developing countries in Figure 1b were relatively stable before the OGF as well, although possibly on a slightly upwards trend. By eyeballing the plot it is difficult to judge whether there was an increase in waste flows during the OGF, since there seems to be an uptake in February to July 2013, but the exports during August to October 2013 seem especially low. However, we should not over-interpret the data plots, since they fail to take into account other

[16] Please refer to the Figure 2 in the Appendix 10.2.

explanatory variables important in explaining the waste trade (e.g. slowdown in growth of China's manufacturing sector or overall shipping costs).

Figure 1: Total waste exports from developed countries to developing countries



(a) Waste exports to China

(b) Waste exports to developing countries excl. China

Source: data from United Nations Comtrade and US Census Bureau

In the Table 1 we report overall summary statistics of quarterly waste exports. It clearly confirms that China is a major waste importer and quarterly exports to China are much larger than average waste exports to other developing countries.

Table 1: Summary statistics for overall quarterly waste exports from developed countries

	mean (t)	sd	min (t)	max (t)
Exports to China	19,637	103,430	.00071	2,095,577
Exports to other developing countries	2,362	18,119	.00015	862,277

Source: data from United Nations Comtrade and US Census Bureau

5.1.4 Sample length

Assuming that the OGF affected the waste exports, we expect to see the effect of the stricter environmental regulation immediately after the start of the intervention, as the operation had been unexpected by the waste exporters. Due to the natural experiment setting, we can measure the average causal immediate effect of the OGF on the waste exports to China (and implications on other developing countries) as a time effect as long as we sufficiently control for the variation due to other variables.

United Nations Comtrade database gives us access to monthly data over the period from January

2010 to December 2015. We limit our sample to only 10 quarters from May 2011 to October 2013 [17] to make sure that during the period of interest the OGF was the only change in China's national legislation regarding waste. As we mentioned in section 2.2, there was a key change in waste import regulations in April 2011, banning hazardous waste imports and setting lower permitted contamination level coming with waste shipments (Ministry of Environmental Protection of the People's Republic of China et al. 2011). Due to the fact that this legislation was enforced by the OGF intervention, we cannot expand our sample period before that date.

We do not extend our sample period after the OGF. After the intervention had finished, there might have been negative and positive long term effects intertwined with positive short term effects on the waste imports to China. In the longer term, the OGF (among other environmental policies) might be interpreted by the waste exporters as an indicator for China's commitment to stronger environmental regulation and thus lead to less waste exported to China. However, in short term, there could have been an increase in waste exports right after the OGF has finished due to potentially low stocks of recyclable materials.

To examine the longer term effect of the OGF, a micro-level analysis is needed to understand structural and technological changes, if any, prompted by the OGF in the each of the waste exporters.[18] Such analysis is out of scope of this paper. Without proper understanding of these changes empirical analysis faces a risk of unobserved variable bias. Furthermore, t_{iwt} captures the importer-waste-specific time trends in the short run, but the linear trends do not necessarily hold in the longer run. We focus only on the short-run effects of the OGF.

Although the OGF lasted until November 2013, we limit the sample until October 2013. We argue that because the end date of the intervention was known, there could have been exports logged in November 2013 that were meant to be imported to China only in December 2013, right after the intervention has finished and the cargo inspection rate was back to normal. Typical shipping time from North America and Europe to China is approximately a month (Cargo From China 2016) and by excluding November we can mitigate the risk of including exports that were to reach China after the OGF.

5.2 Time-variant controls

As we mentioned in section 4.2, we include time-variant explanatory variables to control for any variation over time that is not a direct effect of the OGF.

The importer- and waste- specific time trend (t_{iwt}) captures overall waste trade tendencies like increase/decrease in waste material demanded by an importer i affected by technological changes, growth of different industries, and other reasons. It is important to include time controls for each waste type and importer, because wastes and importers are very diverse. Waste types vary from paper to plastic to metal and it is likely that the demand and supply of these materials follow different trends. For example, improvements in manufacturing processes may require less of a particular material. Change in demand for the final products may have altogether different effects.

[17]The quarters are pushed forward by a month to align them with the beginning of the OGF in February 2013.
[18]Please see section 2.2 for discussion of potential outcomes of the OGF.

Furthermore, different importers may face different prices for recycled and virgin materials based on their national natural resources. For example, China has been opening up and expanding new mines and availability of virgin raw materials has increased. However, this would affect only the wastes that compete with the corresponding mined materials. A new iron ore mine likely would reduce the demand for recyclable iron waste, but not necessarily for recyclable plastic or paper. In result, we assign a separate time trend (t_{iwt}) for each waste type for each importer.

To control for the waste shipment costs we use industry standard Baltic Exchange Dry Index ($lnBDI_t$), which provides a price indicator for moving major raw materials by sea via world's representative bulk cargo trade routes (Baltic Exchange 2016).

In addition, we use the value of total imports ($lnIMP_{eit}$) to country e from country i to control for reverse haulage effects (as well as a one-sided indicator of the size of bilateral trade). As Chaturvedi and McMurray (2015) mentioned, one of the main advantages of exporting waste for recycling to China is the reverse haulage: numerous ships leave China to developed countries fully loaded with goods, but have to return back empty, thus resulting in cheap shipping costs from developed countries to China. Hence, high imports from a developing country may indicate low shipping costs back and, in turn, a potentially more sizable waste trade. Although weight of total imports potentially could be a better indicator for the reverse haulage effects than value, the total weight is not available from the UN Comtrade database. Based on high correlation between total USA import value and weight data from US Census Bureau, we expect the total value and total weight to be highly correlated for other countries as well.

Finally, following Baltagi, Egger, and Pfaffermayr (2003) we include $LGDT_{eit}$, $LSIM_{eit}$, $LRFAC_{eit}$ as controls for bilateral overall country size, relative country size and the absolute difference in relative factor endowments between two trading partners, respectively.

$$LGDT_{eit} = log(GDP_{it} + GDP_{et})$$
$$LSIM_{eit} = log\left[1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{et}}\right)^2 - \left(\frac{GDP_{et}}{GDP_{it} + GDP_{et}}\right)^2\right]$$
$$LRFAC_{eit} = \left|log\left(\frac{GDP_{it}}{capita_{it}}\right) - log\left(\frac{GDP_{et}}{capita_{et}}\right)\right|$$

Unfortunately, we use these three controls only to test our first hypothesis. As these controls are based on GDP estimations, we can only calculate them for developed and some of the developing countries due to limited availability of quarterly GDP data. Thus, we include $LGDT_{eit}$, $LSIM_{eit}$ and $LRFAC_{eit}$ as explanatory variables in section 6.1 to evaluate the effect of the OGF on waste exports to China, but not in section 6.2 where importers' quarterly GDP data is unavailable.[19] Instead, we use a natural logarithm of exporter's real seasonally adjusted GDP as a one-sided proxy.

[19]We tried to limit the sample of importers only to the importers that report quarterly GDP figures, but it was too restrictive leaving only 72 countries out of 193 developing countries and our tests indicated that it would introduce a bias in the sample. It is highly likely that such selection would be not representative of our population, as these countries might be more politically stable or studied more closely by international organisations such as World Bank because of some unique features, that allow collection of this data. Lack of quarterly GDP estimate is also likely to be correlated with small economy and/or small or less developed public services.

5.3 The OGF dummy and conditional controls

To identify the effect of the OGF we include a time dummy OGF_t that takes a value of 1 during the OGF and 0 otherwise. By interacting time variant OGF_t with time invariant dummies, we can identify a conditional OGF effect, examining whether the OGF had affected some groups of waste exporters or importers more than others. Then we can see what was the OGF effect, conditional on: (a) waste exporter typically exporting low quality waste ($lowQexp_{ew}$); (b) waste importer having lax environmental regulation (lax_i); (c) waste importer typically importing low quality waste ($lowQimp_{iw}$).

5.3.1 Low quality waste exporters

The OGF enforced the existing waste quality requirements and by definition only targeted the low quality waste imports (HKPC 2014). However, it is difficult to identify low quality waste since there is no independent measure of waste quality associated with each shipment and we cannot use the average price of waste exports due to price endogeinity to the OGF (MBA Polymers 2013) (please refer to section 4.4 for further details regarding price endogeneity).

In international trade economics it is a common assumption that the differences in prices for goods are predominantly determined by quality differentiation (Hallak 2006). Given that all of the waste we examine is non-hazardous and has economic value to the importer (please see section 5 for details), we can apply the same reasoning. We assume that the lower priced waste (per kg) of the same type (identified by 6-digit HS code) would be of lower quality. Since the price is endogenous to the OGF, we take 2012 as a reference year for any waste quality inferences.

Instead of identifying low quality waste shipments individually, we identify the exporters that had exported low quality waste before the OGF as an instrument for low quality waste imports. $lowQexp_{ew}$ dummy identifies waste exporters e that fall in the lowest average price quartile among all developed exporters that have exported waste w to China during 2012. Therefore, $lowQexp_{ew}$ takes value of 1 for exporters that had exported low quality waste to China for each waste type and 0 otherwise. We do not claim that these countries export only the lowest quality waste, but it does indicate that, on average, the waste exported to China by these countries is of lower quality than the waste exported by other countries. By interacting $lowQexp_{ew}$ with the OGF dummy OGF_t, we can assess the effect of the intervention conditional on exporting country being identified as a low quality waste exporter.

5.3.2 Environmental regulation index

In order to test the hypothesis that during the OGF the waste exports were diverted to developing countries with lax environmental regulation we use two strategies. First, we use an environmental regulation stringency index from the Executive Opinion Survey by World Economic Forum (Blanke and Chiesa 2013). Environmental regulation indexes have been used before by Kellenberg (2012) and Kalamova and Johnstone (2011) for similar purposes in their research.[20] The Executive Opinion Survey follows detailed sampling guidelines to gather opinions of business executives from over 130 countries. Among other questions, the respondents are asked to evaluate environmental regulation and enforcement on the 1 to 7 Likert scale (Browne and Geiger 2011).[21] The results are fairly consistent over the years and 2011-2012 weighted average is appropriate to evaluate the perceptions of leading businesses about the level of environmental regulation before the OGF began.

The main disadvantage of using these indexes is that they are ordinal rather than cardinal (Brunel and Levinson 2016). However, it is not an issue in our case since we only use the index to identify countries that are perceived to have low environmental regulation stringency. In order to do that, we create a dummy (lax_i) for all importers with a score of 3 or lower.[22] We use this dummy to investigate whether developed countries have exported more waste to the identified developing countries during the OGF. If the waste haven theory holds true, we should see an increase of waste exports disproportionally flowing to the identified countries.

5.3.3 Low quality waste importers

The second strategy to identify countries with lax environmental regulation is to identify importers that typically import low quality waste. One concern for relying on general environmental regulation is that it indicates an overall stringency of environmental regulation, but not regulation specific to waste. Identifying countries that import the low quality waste allows us to separate countries that may be considered 'average' on the environmental stringency scale, but have in effect lax environmental regulation when it comes to trade and waste imports.

We follow a similar strategy used to identify low quality exporters. $lowQimp_{iw}$ dummy identifies waste importers i that fall in the lowest average price quartile among all developing countries excluding China that have imported waste w from developed countries during 2012. Therefore, $lowQimp_{iw}$ takes value of 1 for importers that had imported low quality waste from developed countries for each waste type and 0 otherwise. Again, we do not claim that these countries import only the lowest quality waste, but it does indicate that on average the waste imported by these countries is of lower quality than the waste imported by other countries. In turn, these countries should have lax environmental regulation or enforcement to accept the low quality imports, even if it does not coincide with the least stringent environmental regulation destinations.

[20] The questionnaire of Executive Opinion Survey has somewhat changed over the years, but it always includes questions regarding environmental stringency in one shape or another.

[21] Stringency of environmental regulation index: "How would you assess the stringency of your country's environmental regulations?" [1 = very lax; 7 = among the world's most stringent] — 2011–2012 weighted average.

[22] 3 on Likert scale means that the respondent "somewhat agrees" with the statement that environmental regulation is lax in a country.

6 Results

6.1 Exports from developed countries to China

In this section, we present the findings of the OGF effects on exports from developed countries to China, answering our first hypothesis: did low quality waste exports from developed countries to China decrease because of the OGF?

In Table 2 we present the fixed effects regression results. There are 4 regressions, each of them include fixed effects and waste type specific time trends. Regression I includes only the $\delta_0 \times OGF_t$ dummy and regression II also includes the interaction dummy $\delta_1 \times OGF_t \times lowqexp_{ew}$. Regressions III and IV include additional explanatory variables where regression IV is the fully specified model (1).

To aid the interpretation of the results, at the bottom of the table we calculate the conditional OGF effect. $OGF_t \times lowQexp_{ew}$ should be interpreted as the extra effect of the OGF on the group identified by $lowQexp_{ew}$ (i.e. exports coming from low quality exporters). To understand the full effect that the OGF had on this group, we have to look at the conditional OGF effect. The impact of the OGF conditional on exporting country being a low quality exporter is calculated by adding up the coefficients in front of the OGF dummy OGF_t and in front of the dummy interaction $OGF_t \times lowQexp_{ew}$. To calculate the applicable standard error we sum all applicable covariances from the post estimation variance covariance matrix. We report the conditional OGF effect ($OGF_t + OGF_t \times lowQexp_{ew} = OGF_t \times (1 + lowQexp_{ew})$) and applicable standard errors in parenthesis at the bottom of the Table 2.[23]

The regression (I) in Table 2 indicates that during the OGF the waste export flows to China were approximately 10% lower. However, the finding is statistically significant only at 10% significance level. The interaction variable of OGF dummy and low quality exporters ($OGF_t \times lowqexp_{ew}$) is statistically significant throughout the equations II, III, and IV, and is relatively robust to different controls. In addition, once the full set of controls is introduced in regression IV, dummy OGF_t becomes even less significant and close to zero. This indicates that the OGF significantly affected only the low quality waste exports. From Table 2 we can see that the impact of the OGF conditional on exporting country $lowQexp_{ew}$ is a 24% drop in waste exports, while the other waste exports were largely unaffected (as mentioned, the coefficient and standard error in parenthesis of $OGF_t \times (1 + lowqexp_{ew})$ are reported at the bottom of the table). 24% of waste exports comes to approximately 2.5 million tonnes during the OGF. In result, we **fail to reject** our first hypothesis, confirming that low quality waste exports from developed countries to China had decreased during the OGF.

[23]Please refer to Brambor, Clark, and Golder (2006) for a more detailed explanation of interpreting conditional regression results.

Table 2: Regression results for quarterly waste exports from developed countries to China from 2011 May to 2013 October

VARIABLES	(I) ln(Netweight)	(II) ln(Netweight)	(III) ln(Netweight)	(IV) ln(Netweight)
OGF_t	-0.103*	-0.0202	-0.0554	-0.00206
	(0.0581)	(0.0596)	(0.0631)	(0.0584)
$OGF_t \times lowqexp_{ew}$		-0.306**	-0.327***	-0.241**
		(0.115)	(0.104)	(0.0933)
$LGDT_{eit}$			18.20**	8.628
			(7.890)	(7.343)
$LSIM_{eit}$			1.360	-5.444
			(5.844)	(5.399)
$LRFAC_{eit}$			-6.829*	-7.041**
			(3.836)	(3.383)
$lnBDI_t$				-0.214***
				(0.0578)
$lnIMP_{eit}$				1.246***
				(0.0723)
Constant	13.10***	13.10***	-145.2**	-80.68
	(0.0228)	(0.0230)	(56.26)	(52.88)
Observations	5,545	5,545	5,545	5,545
R-squared within	0.060	0.063	0.081	0.185
Number of panel members	851	851	851	851
Fixed Effects	YES	YES	YES	YES
Waste specific trend	YES	YES	YES	YES
Conditional effect of the OGF				
$OGF_t \times (1 + lowqexp_{ew})$		-0.326***	-0.382***	-0.243**
		(0.112)	(0.109)	(0.0991)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

6.2 Exports from developed countries to other developing countries

In this section, we first present the OGF effect on the waste exports to other developing countries; then we assess the significance of stringency of environmental regulation in determining low quality export destinations for the redirected low quality waste.

In Table 3, we present the results exploring the OGF effect on export volumes going into other developing countries. We show the results of a simplistic regression (I) on $lnNetweight_{eitw}$ of exports to other developing countries with the OGF dummy OGF_t. In the regression (II) we add an interaction of the OGF dummy and low quality exporter dummy ($OGF_t \times lowQexp_{ew}$) in order to test for an increase of exports streaming from low quality exporters to other developing countries. Regression (III) corresponds to the fully specified equation (2) with additional time variant controls that fixed effects do not account for. Again, similar to section 6.1 we include the conditional OGF effect at the bottom of the table.

Table 3: Regression results for quarterly waste exports from developed countries to **other** developing countries than China from 2011 May to 2013 October

VARIABLES	(I) ln(Netweight)	(II) ln(Netweight)	(III) ln(Netweight)
OGF_t	0.0274	-0.0165	-0.0108
	(0.0369)	(0.0443)	(0.0363)
$OGF_t \times lowQexp_{ew}$		0.211***	0.174***
		(0.0649)	(0.0560)
$lnGDP_{et}$			8.501***
			(1.345)
$lnBDI_t$			-0.0827*
			(0.0471)
$lnIMP_{eit}$			0.462***
			(0.121)
Constant	10.63***	10.63***	-107.4***
	(0.0138)	(0.0143)	(17.15)
Observations	31,061	31,061	31,061
R-squared within	0.150	0.151	0.201
Number of panel members	8,733	8,733	8,733
Fixed Effects	YES	YES	YES
Importer & waste specific trend	YES	YES	YES
Conditional effect of the OGF			
$OGF_t \times (1 + lowQexp_{ew})$		0.195***	0.163***
		(0.0534)	(0.0509)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

Analysing the results in Table 3, we see that the coefficient next to the OGF dummy OGF_t in regression (I) is positive, indicating that there was a small increase in waste exports to developing countries during the OGF. However, it is not statistically significant. We see a positive, substantial and statistically significant increase in waste exports during the OGF, conditional on exporting country being previously identified as a low quality exporter to China ($lowQexp_{ew}$). These results are statistically significant at 1%. Thus, the exports coming from these countries to other developing nations increased by approximately 16% (please refer to the conditional effect statistics $OGF_t + OGF_t \times lowQexp_{ew}$ in Table 3) as a result of the OGF. A similar dummy interaction in Table 2 accounted for the largest share of the decrease in exports to China. We can infer from these results that the low quality exporters indeed found other destinations in the developing world when the OGF eradicated the market for lowest quality waste in China. On the other hand, the 16% increase in the waste exports to developing countries without China accounts approximately only for 1/3 of the volume decrease in China during the intervention. This means that while a significant amount of low quality waste was redirected to other developing countries, the majority of the low quality waste ended up somewhere else.

At this stage, we are ready to test the full second hypothesis: whether the waste exports from developed countries to other developing countries with lax environmental regulation increased during the OGF. As previously mentioned, we test it using two different identification strategies for the stringency of the regulations: environmental stringency index (lax_i, regression (I) in Table 4), and identifying the low quality importers ($lowQimp_{iw}$, regression (II) in Table 4).

Following our recent discovery that only low quality waste exports to developing countries statistically significantly increased, we run the regressions with an interaction of the OGF dummy, low quality exporters and environmental indicators. This way, we study whether the statistically significant increase from low quality exporters was disproportionally absorbed by countries with lax environmental regulation.[24]

Again, to make our results easier to interpret we added all conditional effect coefficients at the bottom of Table 4. As we can see from the table (complemented by the results in Appendix 10.4), we find little statistically significant evidence that there was a disproportional increase in low quality exports to importers with lax environmental regulation. In result, we reject our second hypothesis. However, we make several relevant observations:

1. The importing countries that were not identified as having lax environmental regulation did not receive higher share of exports from non-low quality exporters. In both models the coefficients next to OGF_t are close to zero and insignificant. This means that countries that have higher environmental regulation and are importing higher quality waste experience no shock as a result of the OGF to the waste exported from non-low quality developed countries.
2. The importing countries that were not identified as countries with lax environment regulation did receive disproportional increase in waste flows from low quality exporters (referring to $OGF_t \times (1 + lowQexp_{ew})$ statistics). This confirms the first part of our second hypothesis that the low quality waste exporters found new destinations for some of the waste redirected from

[24]We also checked if there was an increase in waste exports as a result of the OGF to lax environmental regulation countries from all developed exporters, finding no statistically significant results for both environmental regulation measures. Please refer to Appendix 10.4 for complete results.

China in other developing countries. The result is robust to both environmental regulation indicators (and the estimates of 18% and 22% are relatively similar).

3. Nevertheless, countries that were identified as having lax environmental regulation by ERI (lax_i) did not experience a disproportional increase in waste exports from low quality waste exporters (the conditional coefficient is negative in regression (I) and statistically insignificant). We see a positive increase in waste exports conditional on export coming from non-low quality exporter. Nonetheless, we argue that this finding is unrelated to the OGF, as we do not find higher quality waste exports decline in China. In addition, the coefficient is only significant at 10%, which is a low statistical significance.

4. Furthermore, countries identified as the low quality waste importers ($lowQimp_{iw}$) did not experience a statistically significant increase in the waste exports, low quality or otherwise. On the contrary, we find a relatively significant decline of approximately 17% in waste exports conditional on not coming from the lowest quality waste exporters. We think that the decline might have been a direct result of the OGF, theorising that China's recycling industry that was used to low quality recyclables, now substituted them to higher quality waste to meet their demand for materials. As a result, China might have absorbed a higher share of higher quality materials. However, further research into the topic is needed to provide concrete support for this argument.

5. In addition, our robustness check confirms our findings that it was not the most lax regulatory environments that absorbed disproportional increase in low quality exports. As a robustness check we re-ran a similar regression conditional on waste importer being among the top 5 largest importer (please see Appendix 10.3, Table 11), and find that the largest importers absorbed most of the redirected waste flow from China. In result, we **reject** our second hypothesis, which states that low quality waste exports from developed countries to developing countries with lax environmental regulation increased, as we found no supporting evidence. However, it does not mean that the environmental regulation plays no part in where the waste recycling hubs establish, only that the countries with the least stringent environmental regulation are not necessarily the largest waste importers and do not play a large part in short-term waste flows dynamics.

Table 4: Regression results for quarterly waste exports from developed countries to lax environmental regulation developing countries other than China

VARIABLES	(I) ln(Netweight)	(II) ln(Netweight)
OGF_t	-0.0198	0.0499
	(0.0368)	(0.0447)
$OGF_t \times lowQexp_{ew}$	0.198***	0.174***
	(0.0556)	(0.0597)
$OGF_t \times lax_i$	0.161*	
	(0.0831)	
$OGF_t \times lowQexp_{ew} \times lax_i$	-0.503	
	(0.433)	
$OGF_t \times lowQimp_{iw}$		-0.216**
		(0.0914)
$OGF_t \times lowQexp_{ew} \times lowQimp_{iw}$		0.0147
		(0.117)
$lnGDP_{et}$	8.484***	8.484***
	(1.349)	(1.343)
$lnBDI_t$	-0.0828*	-0.0821*
	(0.0469)	(0.0471)
$lnIMP_{eit}$	0.462***	0.462***
	(0.121)	(0.121)
Constant	-107.2***	-107.2***
	(17.19)	(17.13)
Observations	31,061	31,061
R-squared within	0.201	0.202
Number of panel members	8,733	8,733
Fixed Effects	YES	YES
Importer & waste specific trend	YES	YES
Conditional effect of the OGF		
$OGF_t \times (1 + lowQexp_{ew})$	0.178***	0.224***
	(0.0526)	(0.0555)
$OGF_t \times (1 + lax_i)$	0.141*	
	(0.0839)	
$OGF_t \times (1 + lowQexp_{ew} + lax_i + lowQexp_{ew} \times lax_i)$	-0.165	
	(0.407)	
$OGF_t \times (1 + lowQimp_{iw})$		-0.166**
		(0.0760)
$OGF_t \times (1 + lowQexp_{ew} + lowQimp_{iw} + lowQexp_{ew} \times lowQimp_{iw})$		0.0229
		(0.119)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

7 Robustness checks

To further check the robustness of our results, we conduct four robustness checks to confirm the findings. We do the tests for the first equation designed to examine the first hypothesis: that the exports to China decreased during the OGF. The tests indicate that our results are relatively robust.

First, we re-run the equation (1) on monthly data. We still find that the waste exports from developed exporters have decreased during the OGF in Table 9 in the Appendix 10.3, although the result is smaller (-15% instead of -24%) and only significant at 10% level instead of 1%. We offer two explanations. First, as mentioned in the section 4, there might be a downward bias due to some zeros in the monthly data set being non-random. This is precisely why we have aggregated the results to quarters in the first place. Second, the set of available controls is weaker for the monthly regression (monthly GDP figures are not available for the full set of controls). Thus, we conclude that there is no reason for concern.

Second, we estimate the effect of a 'placebo OGF' in Table 10 in the Appendix 10.3. We move the data sample three quarters backwards and run the regression (1) on the sample of quarterly data from 2010 August to 2013 January, where a $placeboOGF_t$ takes values of 1 from 2012 May to 2013 January. We find that $placeboOGF_t$ had no statistically significant results on the waste exports to China when the full set of controls is employed, which further drives the argument that the OGF effect estimated in section 6 is robust.

Third, to address any concerns regarding the reliability of $lowQimp_{iw}$ explanatory variable we re-run the regression (3) using a different, more complicated indicator of low waste quality importers $lowQimp2_{iw}$. To better identify low quality waste importers, first for each importer we calculate the bottom 10th percentile of 2012 shipments' prices (per kg) for each waste type. By looking at the 10th percentile of shipments instead of simply the lowest price we avoid potential outliers (small low price shipments may distort the bigger picture). In addition, 10th percentile may be a better indicator than the average price used for $lowQimp_{iw}$, because average price may not reflect the width of importer's price distribution (for example, an importer that imports very low quality waste and very high quality waste may have a higher average price than an importer that imports only medium quality waste, whereas we are interested in identifying the former). Second, once we have the 10th percentile, the $lowQimp2_{iw}$ dummy identifies waste importers i that fall in the bottom quartile for each waste type w. Again, we argue that the lowest price reflects the lowest quality, so the lowest price waste importers are importing the lowest quality waste. However, $lowQimp2_{iw}$ gives similar results to $lowQimp_{iw}$ in Table 12 in the Appendix 10.3, finding no support that during the OGF low quality waste was diverted to importers with low environmental regulation.

Fourth, we re-run the regression (1) limiting the sample to the codes that were identified by the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) as codes that require an overseas supplier to hold a recycling certification (AQSIQ 2016). Since authorities of China have not specified a precise definition of waste types that are affected by the OGF, it is possible that these types of waste were more likely to be checked during the OGF. It is also possible that exporters may have tried to re-classify the waste to avoid customs checks to the codes that are less likely to be checked. To limit the sample to HS codes that require certification we need to remove only 5 wastes, namely, 050690 (Bones, Horn-cores: Unworked, Defatted, Degelatinized; Powder and Waste), 700100 (Glass cullet, waste or scrap, glass in the mass), 780200 (Lead waste or scrap), 810820 (Unwrought titanium, powders) and 811100 (Manganese and articles thereof, inc waste and scrap). We see from the results that the OGF effect is somewhat stronger, suggesting an average 27% decline in low quality waste exports compared to the 24% found in the main regression in Table 2 (for the full results please refer to Appendix 10.3 Table 13). The 5 HS codes removed from the sample are very particular and it is unlikely that other waste could be reasonably re-classified into these codes. In addition, the 5 HS codes in question were also negatively affected by the OGF. It is possible that during the OGF waste exporters tried to re-classify waste exports as non-waste, but there have been no reports of such behaviour either.

8 Discussion

The OGF resulted in a large drop of low quality waste exports to China from developed countries. This action has reduced the amount of contaminated waste imported to China and thus the amount of secondary pollution imported. We estimate that because of the OGF, approximately 2.5 million tonnes of low quality waste were not exported to China, which adds to another 1 million tons of illegal waste that were intercepted and rejected on the border by customs officials (China.org.cn 2014). In total, China has reduced low quality waste imports by roughly the amount of household waste produced by Sweden during the same 10 months (Avfall Sverige 2014). In addition, we find that around one third of the low quality waste exports were diverted to other developing countries, though the least stringent environmental regulation destinations experienced no disproportional increase of the waste flows. In this section we discuss our findings in the light of international waste trade theory and examine policy implications and recommendations for further research.

There is no direct answer whether our findings align with pollution haven and waste haven theories. The decrease in low quality waste flows as a result of a more stringent domestic regulation, and, at the same time, increase in exports to other developing countries, seems to support waste haven theory. Nevertheless, we failed to find any support for the argument that the waste was directed to the least stringent environmental regulation destinations. In fact, the largest importers that absorbed the waste increase tend to be ranked as average according to the stringency of environmental regulation index (Blanke and Chiesa 2013). Kellenberg (2008) argues that it is the differences in environmental regulation between the trading country pairs that result in increased waste flows to less stringent regulatory destinations, and compared to developed nations, the largest developing waste importers do have relatively lax environmental laws. However, while environmental regulation may play a larger part in long-term, it does not seem to be significant in short-term recyclable waste dynamics.

Instead of the most environmentally lax, it is the largest waste importers that absorbed the redirected waste flows. It might be that the largest importers have the biggest slack to absorb the extra waste volumes, or that they own the biggest recycling infrastructure, able to work with low quality waste. Examining an example of China, one also may guess that it might be the countries that are transitioning from agriculture based economies to manufacturing. The recyclables are a valuable resource for these countries to produce goods at competitive prices sold internationally.

Nevertheless, in order to explore this hypothesis, further research is needed.

Bringing our findings to policy context, the significant and substantial results of the OGF on low quality waste exports to China support the argument for more stringent domestic policy of large waste importers as a more effective tool of controlling unwanted waste than international law. The fact that only low quality scrap waste was affected, makes it an attractive tool for countries that rely on recyclables as a resource, but want to limit secondary pollution that comes with the waste. In addition, we find that the large amount of the low quality waste exports rejected from China did not reach other developing countries. This provides a basis to argue that encouraging big waste importers to improve their environmental regulation and enforcement might be a better strategy to manage overall international waste flows than international collaboration. Nevertheless, one has to keep in mind that the size of international impact is due to China's importance as a global player, and larger importer should be targeted.

Due to our short term focus on the effects of the intervention, it is hard to extrapolate whether the OGF resulted in a reduction of low quality waste in the long term. In addition, one has to keep in mind that the OGF was an intervention to enforce existing regulation, not to introduce new laws, meaning that any domestic regulation in developing countries has to be stringently enforced to have a full effect. Given that developing countries usually lack resources to enforce the existing laws, it might be a call for international actors to support developing countries in enforcing domestic environmental standards to achieve international impact.

8.1 Recommendations for further research

Despite the significant growth and size of the international waste trade, we believe the subject has been somewhat overlooked in academia. The studies on the effects of changes in domestic environmental regulation on domestic and international waste trade are crucial in understanding the industry dynamics and making right choices when it comes to advocacy for international cooperation and support for stronger environmental laws.

We recommend further research into the OGF to answer the remaining questions about the total impact of the intervention. Normative assessment of the OGF is beyond the scope of this paper. We cannot conclude if the OGF helped or aggravated environmental pollution problems on the global scale. Another topic to explore is the fate of the other 2/3 of the waste that was not diverted to the developing countries. There is some anecdotal evidence that some rejected shipments were cleaned to be readmitted to China (Recycling International 2013c). If this is found true on a large scale, it might mean that the intervention resulted in an increase in the overall quality of scrap waste traded internationally. At the same time, it might partially explain the increase in low quality waste exports to other developing countries. On the other hand, there is a possibility that the rejected waste was land-filled. It is possible that the OGF resulted in less secondary pollution in China, but more pollution overall. There is also the possibility that due to the relatively short period of intervention (10 months), the exporters might have delayed the low quality shipments until the intervention ended, shipping the accumulated amount to China in later months. Although we argue that this is unlikely due to high volumes of the waste and expensive costs of storing, the further research into this or other previously mentioned questions would enrich the understanding of the

OGF effect and waste trade overall.

Another interesting topic for investigation would be understanding the underlying reasons for our three developed exporters outliers - Estonia, Greece, and Slovakia. While there is a chance of a simple data inputting error, the significant spike in exports to China just around the end of the OGF may reveal an interesting dynamic of international trade waste. The research is complicated by lack of secondary sources and requires primary research.

Finally, in order to make the policy recommendations stronger, the long term effects of the intervention should be studied. There is some anecdotal evidence that the intervention spurred domestic recyclers to innovate in order to recycle a larger share of the waste internally (MBA Polymers 2013). In addition, various industry sources argue for permanent decline in waste exports to China as a result of the OGF (Recycling International 2013c). To determine whether any of these statements are true, further research into the topic is crucial.

9 Conclusions

Every year international waste trade moves hundreds of millions of tonnes of waste from developed to developing countries, bringing secondary pollution together with recyclable materials. To the best of our knowledge, our thesis is the first in the field to examine if domestic regulation can be an effective way to alter the waste movements from developed to the developing world. Examining the OGF intervention in China, we find that low quality exports from developed countries to China declined by 24% on average during the intervention. At the same time, the low quality waste exports from developed countries to other developing countries on average increased by 16%. While there is a clear indication that waste trade flows were redirected from China to other developing countries, they absorbed only a part of the diverted waste flows. Hence, we find that the OGF resulted in an overall decline in low quality waste exported to developing countries. Because the intervention had a significant effect only on low quality waste, the average quality of the traded waste has increased, possibly resulting in less secondary pollution ending up in developing countries overall.

Testing the waste haven theory, we examined if the low quality waste flows during the OGF were redirected to the least stringent environmental regulation destinations. Our thesis does not find support for this hypothesis, with both of our explanatory variables for weak environmental regulation stringency returning insignificant. We propose further research into the short-term dynamics of waste trade.

The OGF intervention reduced low quality waste flows from developed to developing countries in the short term. To evaluate the full impact of the intervention, further research is needed to investigate long term effects of the OGF. However, local enforcement of more stringent environmental regulation in large waste importers is a promising tool for governments and international organisations to fight the negative aspects of the international waste trade.

References

Alam, Pervez, and Kafeel Ahmade. 2013. "Impact of Solid Waste on Health and Environment." *International Journal of Sustainable Development and Green Economics* 2 (1): 165–168.

Asia Times. 1999. "Philippines Bins Japanese Trash Trade." Visited on 04/16/2016. http://www.atimes.com/se-asia/AL16Ae01.html.

Avfall Sverige. 2014. "Swedish Waste Management." Visited on 05/19/2016. http://www.avfallsverige.se/fileadmin/uploads/Rapporter/sah_2014_Eng_141001.pdf.

Baggs, Jen. 2009. "International Trade in Hazardous Waste." *Review of International Economics* 17 (1): 1–16.

Baltagi, Badi H., Peter Egger, and Michael Pfaffermayr. 2003. "A Generalized Design for Bilateral Trade Flow Models." *Economics Letters* 80 (3): 391–397.

Baltic Exchange, The. 2016. "Baltic Exchange Dry Index." Visited on 04/02/2016. http://www.balticexchange.com.

Blanke, Jennifer, and Thea Chiesa, eds. 2013. *The Travel & Tourism Competitiveness Report 2013.* Geneva: The World Economic Forum.

Brambor, Thomas, William Roberts Clark, and Matt Golder. 2006. "Understanding Interaction Models: Improving Empirical Analyses." *Political Analysis* 14 (1): 63–82.

Browne, Ciera, and Thierry Geiger. 2011. "The Executive Opinion Survey: an Indispensable Tool in the Assessment of National Competitiveness." *The Global Competitiveness Report* 2012:75–83.

Brunel, Claire, and Arik Levinson. 2016. "Measuring the Stringency of Environmental Regulations." *Review of Environmental Economics and Policy* 10 (1): 47–67.

Cameron, A. Colin, and Douglas L. Miller. 2015. "A Practitioner's Guide to Cluster-Robust Inference." *Journal of Human Resources* 50 (2): 317–372.

Cargo From China. 2016. "China Sea Freight Shipping – Everything You Need to Know." Visited on 05/03/2016. https://cargofromchina.com/sea-freight/.

Chaturvedi, Ashish, and Nicole McMurray. 2015. "China's Emergence as a Global Recycling Hub–What Does it Mean for Circular Economy Approaches Elsewhere?" Evidence Report No 146. Brighton: Institute of Development Studies.

China.org.cn. 2014. "Solid Waste Smuggling Sees Threefold Rise." Visited on 04/07/2016. http://www.china.org.cn/environment/2014-05/27/content_32499228.htm.

Chintrakarn, Pandej, and Daniel L. Millimet. 2006. "The Environmental Consequences of Trade: Evidence from Subnational Trade Flows." *Journal of Environmental Economics and Management* 52 (1): 430–453.

Earley, Katharine. 2013. "Could China's 'Green Fence' Prompt a Global Recycling Innovation?" Visited on 04/07/2016. http://www.theguardian.com/sustainable-business/china-green-fence-global-recycling-innovation.

Flower, Will. 2016. "What Operation Green Fence Has Meant for Recycling." Visited on 05/31/2016. http://waste360.com/business/what-operation-green-fence-has-meant-recycling.

General Administration of Customs. 2013. “General Administration of Customs on Strengthening the Supervision of Solid Waste Imported to Crack down on ”Foreign Garbage” Smuggling Notice.” Visited on 04/05/2016. http://www.customs.gov.cn/publish/portal0/tab49685/info434196.htm.

General Administration of Quality Supervision, Inspection and Quarantine of the People’s Republic of China (AQSIQ). 2016. “Recycling Certification.” Visited on 02/11/2016. http://www.aqsiq.net/importer-list.htm.

Ghosh, Sucharita. 2011. “Book Review. The Gravity Model in International Trade. Advances and Applications.” *Review of International Economics* 19 (5): 979–981.

Grossman, Gene M., and Elhanan Helpman. 1994. “Protection for Sale.” *American Economic Review* 84 (4): 833–850.

Hallak, Juan Carlos. 2006. “Product Quality and the Direction of Trade.” *Journal of International Economics* 68 (1): 238–265.

Hong Kong Information Services Department. 2013. “LCQ6: Operation Green Fence and Steering Committee to Promote Sustainable Development of Recycling Industry.” Visited on 04/07/2016. http://www.info.gov.hk/gia/general/201311/20/P201311200626.htm.

Hong Kong Productivity Council, Environmental Management Division. 2014. “A Study to Promote Recycling of Plastic, Paper and Used Cooking Oil in Hong Kong. Final Report.” Visited on 01/20/2016. http://www.legco.gov.hk/yr13-14/english/panels/ea/papers/ea0328cb1-417-1-e.pdf.

Jacobs, David E. 1995. “Managing Hazardous and Nonhazardous Waste: How To Do It.” In *Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing*, ed. by July LaKind et al. Darby: DIANE Publishing.

Jaffe, Adam B., et al. 1995. “Environmental Regulation and the Competitiveness of US Manufacturing: What Does the Evidence Tell Us?” *Journal of Economic Literature* 33:132–163.

Jansen, Kerri. 2013. “China Getting Tough on Contamination.” Visited on 03/10/2016. http://www.plasticsnews.com/article/20130506/NEWS/130509963/china-getting-tough-on-contamination.

Japan Ministry of the Environment. 2011. “Summary of Questionnaire Survey for Asian Network Workshop in Cambodia.” Asian Network for Prevention of Illegal Transboundary Movement of Hazardous Wastes. Visited on 04/28/2016. http://www.env.go.jp/en/recycle/asian_net/Annual_Workshops/2010_II_PDF/Additional_Paper/QuestionnaireSummary.pdf.

Johnson, Jay, Gary Pecquet, and Leon Taylor. 2007. “Potential Gains from Trade in Dirty Industries: Revisiting Lawrence Summer’s Memo.” *Cato Journal* 27 (3): 397–410.

Kalamova, Margarita, and Nick Johnstone. 2011. “Environmental Policy Stringency and Foreign Direct Investment.” In *A Handbook of Globalisation and Environmental Policy, Second Edition: National Government Interventions in a Global Arena*, ed. by Frank Wijen et al., 57–88. Cheltenham: Edward Elgar Publishing.

Kareem, Olanike Fatima, and Idowu Olayinka Kareem. 2014. “Specification and Estimation of Gravity Models: a Review of the Issues in the Literature.” EUI Working Paper RSCAS 2014/74, European University Institute, Robert Schuman Centre for Advanced Studies, San Domenico di Fiesole.

Kellenberg, Derek. 2008. “A Reexamination of the Role of Income for the Trade and Environment Debate.” *Ecological Economics* 68 (1-2): 106–115.

– . 2015. “The Economics of the International Trade of Waste.” *Annual Review of Resource Economics* 7 (1): 109–125.

– . 2012. “Trading Wastes.” *Journal of Environmental Economics and Management* 64 (1): 68–87.

Kellenberg, Derek, and Arik Levinson. 2014. “Waste of Effort? International Environmental Agreements.” *Journal of the Association of Environmental and Resource Economists* 1 (1): 135–169.

Kojima, Michikazu, and Aya Yoshida. 2005. “Hong Kong—The Transit-port for Recyclable Wastes & Secondhand Goods.” In *International Trade of Recyclable Resources in Asia*, ed. by Kojima Michikazu, 53–62. Chiba: Institute of Developing Economies (IDE), Japan External Trade Organization (JETRO).

Krueger, Jonathan. 2001. “The Basel Convention and the International Trade in Hazardous Wastes.” *Yearbook of International Co-operation on Environment and Development* 2001/2002:43–51.

Levinson, Arik, and M. Scott Taylor. 2008. “Unmasking the Pollution Haven Effect.” *International Economic Review* 49 (1): 223–254.

Linders, Gert-Jan, and Henri L. F. De Groot. 2006. “Estimation of the Gravity Equation in the Presence of Zero Flows.” Tinbergen Institute Discussion Paper No. 06-072/3, Amsterdam.

MBA Polymers. 2013. “How is China’s ’Green Fence’ Affecting the Global Recycling Trade?” Visited on 04/07/2016. http://www.mbapolymers.com/home/news-green-fence.

Ministry for Foreign Affairs of Iceland. 2016. “Free Trade Agreement between Iceland and China.” Visited on 02/11/2016. https://www.mfa.is/foreign-policy/trade/free-trade-agreement-between-iceland-and-china/.

Ministry of Environmental Protection of the People’s Republic of China et al. 2011. “AQSIQ Decree 12 of 2011.” Visited on 04/04/2016. http://www.customs.gov.cn/publish/portal0/tab399/info310245.htm.

Powell, Jerry. 2013. “Operation Green Fence is Deeply Affecting Export Markets.” Visited on 04/07/2016. http://resource-recycling.com/node/3679.

Pratt, Laura A. 2011. “Decreasing Dirty Dumping? A Reevaluation of Toxic Waste Colonialism and the Global Management of Transboundary Hazardous Waste.” *William & Mary Environmental Law and Policy Review* 35 (581-623).

Ray, Amit. 2008. “Waste Management in Developing Asia: Can Trade and Cooperation Help?” *The Journal of Environment & Development* 17 (1): 3–25.

Recycling International. 2013a. “China’s Import Demands ’Not Unreasonable’.” Visited on 04/07/2016. http://www.recyclinginternational.com/recycling-news/7012/research-and-legislation/china/china-039-s-import-demands-039-not-unreasonable-039.

– . 2013b. “’Green Fence’ Barrier to China’s Plastic Imports.” Visited on 04/07/2016. http://www.recyclinginternational.com/recycling-news/7086/plastic-and-rubber/china/039-green-fence-039-barrier-china-039-s-plastic-imports.

– . 2013c. “Plastics Experts Assess ’Green Fence’ Impact.” Visited on 04/07/2016. http://www.recyclinginternational.com/recycling-news/7338/plastic-and-rubber/united-states/plastics-experts-assess-039-green-fence-039-impact.

Recycling Today. 2014. "ISRI Convention: China's Green Fence." Visited on 03/18/2016. http://www.recyclingtoday.com/article/isri-convention-2013-green-fence/.

Schaffer, Mark, and Steven Stillman. 2006. *XTOVERID: Stata Module to Calculate Tests of Overidentifying Restrictions after xtreg, xtivreg, xtivreg2, xthtaylor*. Statistical Software Components, Boston College Department of Economics.

Secretariat of the Basel Convention. 2005. *Minimizing Hazardous Wastes: a Simplified Guide to the Basel Convention*. United Nations Environment Programme, Geneva.

– . 1999. "The Basel Ban - a Triumph for Global Environmental Justice." Briefing Paper: No. 1. Visited on 05/02/2016. http://archive.ban.org/library/briefing1.html.

State Environmental Protection Administration of China (SEPA) and General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (AQSIQ). 2005. *Environmental Protection Control Standards for Imported Solid Wastes as Raw Materials (GB 16487)*.

UN Comtrade. 2016. "United Nations Commodity Trade Statistics Database." Visited on 05/02/2016. http://comtrade.un.org.

US Census Bureau. 2016. "USA Trade Online." Visited on 05/02/2016. https://usatrade.census.gov.

Vangel Inc. 2013. "What Does China's Green Fence Mean for the Recycling Industry?" Visited on 04/07/2016. http://vangelinc.com/recycling/exporting-recycling/what-does-chinas-green-fence-mean-for-the-recycling-industry.

Velis, Costas. 2014. "Global Recycling Markets – Plastic Waste: a Story for One Player – China." International Solid Waste Association.

Wooldridge, Jeffrey M. 2013. *Introductory Econometrics: A Modern Approach*. 5., international edition. Florence: South-Western/Cengage Learning.

Xiong, Bo, and John Beghin. 2011. "Disentangling the Demand-Enhancing Effect and Trade-Cost Effect of Technical Measures in Agricultural Trade among OECD Countries." Available at SSRN 1945235.

Xu, Xinpeng, and Ligang Song. 2000. "Regional Cooperation and the Environment: Do 'Dirty' Industries Migrate?" *Weltwirtschaftliches Archiv* 136 (1): 137–157.

10 Appendices

10.1 Summary statistics of explanatory variables

Table 5: Explanatory variables for part 1: waste exports to China

Explanatory variable	count	mean	var	min	max
OGF_t	5545	.292	.207	0	1
$lowQexp_{ew}$	5545	.268	.196	0	1
$LGDT_{eit}$	5545	12.3	4.10	8.26	16.6
$LSIM_{eit}$	5545	-4.21	3.84	-8.44	-.70
$LRFAC_{eit}$	5545	8.72	2.81	3.43	10.7
$lnBDI_t$	5545	6.94	.084	6.50	7.56
$lnIMP_{eit}$	5545	22.2	3.31	16.4	25.5

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

Source: data from UN Comtrade, US Census Bureau, Baltic Dry Index Exchange, and various national statistics offices

Table 6: Explanatory variables for part 2: waste exports to developing countries other than China

Explanatory variable	count	mean	var	min	max
OGF_t	31061	.297	.209	0	1
$lowQexp_{ew}$	31061	.200	.159	0	1
lax_i	31061	.073	.068	0	1
$lowQimp_{iw}$	31061	.279	.201	0	1
$largeIMP_i$	29816[a]	.395	.239	0	1
$lnGDP_{et}$	31061	13.0	4.87	7.70	16.58
$lnBDI_t$	31061	7.02	.082	6.70	7.47
$lnIMP_{eit}$	31061	18.1	16.8	1.00e-06	23.5

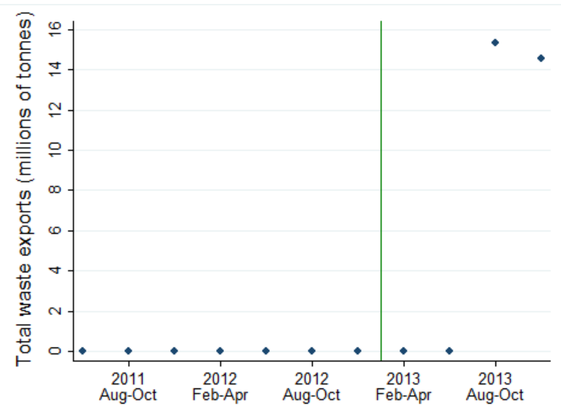
[a] The number of observations as well as panel members decreased as the importers who had zero observations in the year 2012 could not be ranked as largest/smallest importers of waste in 2012 and had to be eliminated

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

Source: data from UN Comtrade, US Census Bureau, Baltic Dry Index Exchange, and various national statistics offices

10.2 Additional information on data sample

Figure 2: Waste exports from Estonia, Greece and Slovakia to China



Source: data from United Nations Comtrade and US Census Bureau

Table 7: Waste exporters and importers included in the sample

Developed waste exporters			
Australia	Denmark	Lithuania	Romania
Austria	Finland	Luxembourg	Slovenia
Belgium	France	Malta	Spain
Bulgaria	Germany	Mexico	Sweden
Canada	Hungary	Netherlands	Switzerland
Chile	Ireland	New Zealand	Turkey
Croatia	Italy	Norway	United Kingdom
Cyprus	Japan	Poland	United States of America
Czech Rep	Latvia	Portugal	
Developing waste importers			
Afghanistan	Curacao	Libya	San Marino
Albania	Dem. People's Rep. of Korea	Madagascar	Sao Tome and Principe
Algeria	Dem.Rep. of the Congo	Malawi	Saudi Arabia
American Samoa	Djibouti	Malaysia	Senegal
Andorra	Dominica	Maldives	Serbia
Angola	Dominican Rep.	Mali	Seychelles
Anguilla	Ecuador	Marshall Isds	Sierra Leone
Antarctica	Egypt	Mauritania	Singapore
Antigua and Barbuda	El Salvador	Mauritius	Sint Maarten (Dutch part)
Argentina	Equatorial Guinea	Mayotte	Solomon Isds
Armenia	Eritrea	Mongolia	Somalia
Aruba	Ethiopia	Montenegro	South Africa
Azerbaijan	Faeroe Isds	Montserrat	Special Categories
Bahamas	Falkland Isds (Malvinas)	Morocco	Sri Lanka
Bahrain	Fiji	Mozambique	State of Palestine
Bangladesh	Free Zones	Myanmar	Sudan
Barbados	French Polynesia	Namibia	Suriname
Belarus	Gabon	Nauru	Swaziland
Belize	Gambia	Nepal	Syria
Benin	Georgia	Neth. Antilles	Tajikistan
Bermuda	Ghana	New Caledonia	TFYR of Macedonia
Bhutan	Gibraltar	Nicaragua	Thailand
Bolivia	Greenland	Niger	Timor-Leste
Bosnia Herzegovina	Grenada	Nigeria	Togo
Br. Virgin Isds	Guam	Niue	Tonga
Brazil	Guatemala	Oman	Trinidad and Tobago
Brunei Darussalam	Guinea	Other Africa, nes	Tunisia
Bunkers	Guinea-Bissau	Other Areas, nes	Turkmenistan
Burkina Faso	Guyana	Other Asia, nes	Turks and Caicos Isds
Burundi	Haiti	Pakistan	Tuvalu
Cote d'Ivoire	Heard Isd and McDonald Isds	Palau	Uganda
Cabo Verde	Honduras	Panama	Ukraine
Cambodia	India	Papua New Guinea	United Arab Emirates
Cameroon	Indonesia	Paraguay	United Rep. of Tanzania
Cayman Isds	Iran	Peru	U.S. Minor Outlying Islands
Central African Rep.	Iraq	Philippines	Uruguay
Chad	Jamaica	Qatar	Uzbekistan
China, P.R. (incl. Hong Kong)	Jordan	Rep. of Moldova	Vanuatu
Christmas Isds	Kazakhstan	Russian Federation	Venezuela
Cocos Isds	Kenya	Rwanda	Viet Nam
Colombia	Kiribati	Saint Helena	Wallis and Futuna Isds
Comoros	Kuwait	Saint Kitts and Nevis	Yemen
Congo	Kyrgyzstan	Saint Lucia	Zambia
Cook Isds	Lao People's Dem. Rep.	Saint Pierre and Miquelon	Zimbabwe
Costa Rica	Lebanon	Saint Vincent and the Grenadines	
Cuba	Liberia	Samoa	

Source: based on data from UN Comtrade and US Census Bureau

Table 8: HS codes included in the sample, with description

6-digit HS code	**Description**
050690	Bones, Horn-cores (Unworked, Defatted, Degelatinized); Powder and Waste
170310	Cane molasses
170390	Molasses, except cane molasses
261800	Granulated slag (slag sand) from iron, steel industry
261900	Waste, scale, dross, slag of iron or steel industry
262019	Ash or residues containing mainly zinc (not spelter)
262099	Ash & residues (excl. from the mfr. of iron/steel)
280461	Silicon, >99.99% pure
391510	Polyethylene waste or scrap
391520	Polystyrene waste or scrap
391530	Polyvinyl chloride waste or scrap
391590	Plastics waste or scrap of other plastics
400400	Waste, parings and scrap of rubber (except hard rubber)
411520	Parings & oth. waste of leather/composition leather, not suit. for the mfr.
450190	Waste cork, crushed, granulated or ground
470710	Waste or scrap of unbleached kraft or paperboard
470720	Waste, scrap of paper, board of bleached chemical pulp
470730	Waste or scrap of paper or board of mechanical pulp
470790	Waste, scrap of paper, board, other (including unsorted)
510310	Noils of wool or of fine animal hair
510320	Waste of wool or fine hair, not noils, garnetted stoc
520210	Cotton yarn waste (including thread waste)
520291	Garnetted stock of cotton
520299	Cotton waste, except garnetted stock
550510	Waste of synthetic fibres
550520	Waste of artificial fibres
631010	Used or new rags textile material, sorted
631090	Used or new rags textile material, not sorted
700100	Glass cullet, waste or scrap, glass in the mass
711291	Waste & scrap of gold, incl. metal clad with gold but excl. sweepings
711292	Waste & scrap of platinum, incl. metal clad with platinum but excl. sweepings
720410	Waste or scrap, of cast iron
720421	Waste or scrap, of stainless steel
720429	Waste or scrap, of alloy steel, other than stainless
720430	Waste or scrap, of tinned iron or steel
720441	Waste from the mechanical working of iron or steel, other
720449	Ferrous waste or scrap, other
720450	Remelting scrap ingots, of iron or steel
740400	Copper/copper alloy waste or scrap
750300	Nickel waste or scrap
760200	Waste or scrap, aluminium
780200	Lead waste or scrap
790200	Zinc waste or scrap
810197	Tungsten (wolfram) waste & scrap
810330	Tantalum waste & scrap
810420	Magnesium waste or scrap
810600	Bismuth, articles thereof, waste or scrap
810820	Unwrought titanium, powders
810830	Titanium waste & scrap
810930	Zirconium waste & scrap
811100	Manganese and articles thereof, inc waste and scrap
811292	Gallium, hafnium, indium, niobium (columbium) & rhenium, unwrought; waste & scrap
811300	Cermets and articles thereof, waste or scrap
890800	Vessels and other floating structures for breaking up

Source: based on UN Comtrade HS code classification

10.3 Results for robustness checks

Table 9: Robustness checks: running same model on a monthly data

VARIABLES	(I) ln(Netweight)	(II) ln(Netweight)	(III) ln(Netweight)
OGF_t	-0.0203	0.0505	0.105**
	(0.0522)	(0.0489)	(0.0503)
$OGF_t \times lowQexp_{ew}$		-0.261***	-0.256***
		(0.0783)	(0.0778)
$lnBDI_t$			-0.0805**
			(0.0369)
$lnIMP_{eit}$			0.358***
			(0.0866)
Constant	12.75***	12.75***	5.722***
	(0.0464)	(0.0465)	(1.861)
Observations	13,984	13,984	13,984
R-squared within	0.031	0.034	0.036
Number of panel members	853	853	853
Fixed Effects	YES	YES	YES
Waste specific trend	YES	YES	YES
Conditional effect of the OGF			
$OGF_t \times (1 + lowQexp_{ew})$		-0.211**	-0.151*
		(0.0900)	(0.0850)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

Table 10: Robustness checks: Placebo intervention from 2012 May to 2013 January during 2010 August to 2013 January period

VARIABLES	(I) ln(Netweight)	(II) ln(Netweight)	(III) ln(Netweight)	(IV) ln(Netweight)
$placeboOGF_t$	-0.266***	-0.275***	-0.00957	-0.0586
	(0.0722)	(0.0859)	(0.0826)	(0.0830)
$placeboOGF_t \times lowQexp_{ew}$		0.0323	0.0299	0.0420
		(0.138)	(0.125)	(0.118)
$LGDT_{eit}$			41.17***	39.70***
			(4.704)	(4.440)
$LSIM_{eit}$			12.14***	12.13***
			(4.035)	(3.764)
$LRFAC_{eit}$			-19.16***	-20.42***
			(2.098)	(1.993)
$lnBDI_t$				0.0298
				(0.0488)
$lnIMP_{eit}$				1.052***
				(0.0735)
Constant	12.67***	12.67***	-271.7***	-266.0***
	(0.0292)	(0.0293)	(37.76)	(35.79)
Observations	5,576	5,576	5,576	5,576
R-squared within	0.040	0.040	0.072	0.130
Number of panel members	848	848	848	848
Fixed Effects	YES	YES	YES	YES
Waste specific trend	YES	YES	YES	YES
Conditional effect of the placebo OGF				
$placeboOGF_t \times (1 + lowQexp_{ew})$		-0.243**	0.0204	-0.0166
		(0.116)	(0.111)	(0.104)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

Table 11: Robustness check: effect of the OGF on export flows from low quality waste exporting developed countries to top 5 largest importers of waste by waste type

VARIABLES	(I) ln(Netweight)
OGF_t	-0.00349
	(0.0407)
$OGF_t \times lowQexp_{ew}$	0.119
	(0.0715)
$OGF_t \times largeIMP_{iw}$	-0.0191
	(0.0551)
$OGF_t \times lowQexp_{ew} \times largeIMP_{iw}$	0.102
	(0.123)
$lnGDP_{et}$	8.523***
	(1.350)
$lnBDI_t$	-0.0788
	(0.0472)
$lnIMP_{eit}$	0.469***
	(0.124)
Constant	-107.6***
	(17.15)
Observations	29,816[a]
R-squared within	0.194
Number of panel members	7,752[a]
Fixed Effects	YES
Importer & waste specific trend	YES
Conditional effect of the OGF	
$OGF_t \times (1 + lowQexp_{ew})$	0.115
	(0.0703)
$OGF_t \times (1 + largeIMP_{iw})$	-0.0226
	(0.0495)
$OGF_t \times (1 + lowQexp_{ew} + largeIMP_{iw} + lowQexp_{ew} \times largeIMP_{iw})$	0.198**
	(0.0812)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

[a] The number of observations as well as panel members decreased as the importers who had zero observations in the year 2012 could not be ranked as largest/smallest importers of waste in 2012 and had to be eliminated

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

While we hypothesise that the developed countries will divert the waste exports to developing countries with the least stringent environmental regulation during the OGF, we also want to allow for the possibility that the waste flows were simply diverted to other large waste recycling hubs (see Table 11). We identify the 5 largest waste importers i for each waste type w during 2012 and create the dummy $largeIMP_{iw}$.

We find that the whole increase in waste exports from low quality exporters were absorbed by the top five largest importers for each waste type. According to our findings, the largest importers witnessed an 20% increase in waste exports coming from low quality waste exporters (please refer to the coefficient next to $OGF_t \times (1 + lowQexp_{ew} + largeIMP_{iw} + lowQexp_{ew} \times largeIMP_{iw})$, which is found statistically significant at 5%). In result, the largest importers absorb most of the waste increase from low quality exporters destined to other developing countries. As the largest importers of each waste type do not coincide with the countries with the most lax environmental regulation, this further provides support for rejecting the second hypothesis.

Table 12: Robustness checks: testing $lowQimp2_{iw}$ as an alternative measure for $lowQimp_{iw}$

VARIABLES	(I) ln(Netweight)
OGF_t	0.0322
	(0.0409)
$OGF_t \times lowQimp2_{iw}$	-0.0223
	(0.0832)
$lnGDP_{et}$	8.605***
	(1.355)
$lnBDI_t$	-0.0829*
	(0.0470)
$lnIMP_{eit}$	0.462***
	(0.121)
Constant	-108.7***
	(17.22)
Observations	31,061
R-squared within	0.201
Number of panel members	8,733
Fixed Effects	YES
Waste specific trend	YES
Conditional effect of the OGF	
$OGF_t \times (1 + lowQimp2_{iw})$	0.00992
	(0.0653)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

Table 13: Robustness checks: running regression only on HS codes identified by AQSIQ

VARIABLES	(I) lnNetweight	(II) lnNetweight	(III) lnNetweight	(IV) lnNetweight
OGF_t	-0.0934	0.00190	-0.0363	0.0189
	(0.0593)	(0.0614)	(0.0658)	(0.0608)
$OGF_t \times lowQexp_{ew}$		-0.352***	-0.374***	-0.293***
		(0.117)	(0.109)	(0.0958)
$LGDT_{eit}$			18.47**	7.996
			(8.098)	(7.515)
$LSIM_{eit}$			1.552	-5.491
			(6.006)	(5.523)
$LRFAC_{eit}$			-7.105*	-6.880**
			(3.871)	(3.393)
$lnBDI_t$				-0.178***
				(0.0501)
$lnIMP_{eit}$				1.223***
				(0.0726)
Constant	13.22***	13.22***	-144.6**	-73.67
	(0.0233)	(0.0235)	(57.81)	(54.31)
Observations	5,260	5,260	5,260	5,260
R-squared	0.061	0.066	0.084	0.187
Number of panel members	794	794	794	794
Fixed Effects	YES	YES	YES	YES
Waste specific trend	YES	YES	YES	YES
Conditional effect of the OGF				
$OGF_t \times (1 + lowQexp_{ew})$		-0.350***	-0.410***	-0.274***
		(0.114)	(0.113)	(0.101)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

10.4 Additional results testing environmental regulation hypothesis

Table 14: Effect of the OGF on export flows from developed to lax environmental regulation developing countries

VARIABLES	(I) ln(Netweight)	(II) ln(Netweight)
OGF_t	0.0216	0.0322
	(0.0323)	(0.0409)
$OGF_t \times lax_i$	0.0625	
	(0.0984)	
$OGF_t \times lowQimp_{iw}$		-0.206**
		(0.0895)
$lnGDP_et$	8.601***	8.605***
	(1.355)	((1.355)
$lnBDI_t$	-0.0829*	-0.0829*
	(0.0470)	(0.0470)
$lnIMP_{eit}$	0.462***	0.462***
	(0.121)	(0.121)
Constant	-108.7***	-108.7***
	(17.22)	(17.22)
Observations	31,061	31,061
R-squared within	0.201	0.201
Number of panel members	8,733	8,733
Fixed Effects	YES	YES
Importer & waste specific trend	YES	YES
Conditional effect of the OGF		
$OGF_t + OGF_t \times lax_i$	0.0840	
	(0.0956)	
$OGF_t \times lowQimp_{iw}$		0.00992
		(0.0653)

Robust standard errors in parentheses (clustered around waste type HS)
*** p<0.01, ** p<0.05, * p<0.1

Note: for detailed description of explanatory variables please see sections 5.2 and 5.3

The results in the Table 14 are presented for the model below:

$$y_{eiwt} = \mathbf{x'}_{eit}\beta + \alpha_{iew} + t_{iwt} + \delta_0 \times OGF_t + \delta_1 \times OGF_t \times ENV_i + \epsilon_{eiwt} \tag{4}$$

where y is the logarithm of the weight of waste exports
$\mathbf{x'}_{eit}$ is a vector of explanatory variables: $lnBDI_t$, $lnIMP_{eit}$, and $lnGDP_{et}$
α_{iew} is the importer-exporter-waste fixed effect
t_{iwt} is the importer and waste type specific time trend
OGF_t is OGF dummy
$lowQexp_{ew}$ is a dummy variable for low quality waste exporters
ENV_i is a dummy for environmentally lax regulation in importing country